DEPARTMENT OF THE INTERIOR WHITE STATES

Preliminary report on the engineering geology of the Eldorado Springs quadrangle, Boulder and Jefferson Counties, Colorado OPEN FILE - 1969 Sheet 3 of 5 sheets

OROLOUZCAL	PLATES . SURVEY	SUSPENDENCE OF THE PARTY OF THE	Ger	meralised description of	engineering geologic aspe	cts 8f surficial deposits	in the Eldorado Springs q	undrangle, Colorado			Sheet 3 of 5 she	reta .
Engineering goology unit name and map symbol	Squivalent grologie unit (s)	Description and thickness	Topographic form and surface relief	Weathering and ancient soils	Workability	Surface drainage and erosifn	Ground water	Suitability for waste disposal	Foundation stability	Slope stability	Probable earthquake stability	Use
Smitney landfill for dig	ng egglionile.	thate and rubbish, excluding garbage; some logs and broken searcrate. Heacompached; density extremely variable; compressibility high where definity low. Covered and locally interlayered with earth 1-3 ft thick. Yould thickness as much as 25 ft.	Bearly level where covered by earthfill: irregularly uneven surface elsewhere.		Excavation: varies; easy to difficult with power equipment. Compaction: generally moderately difficult; improved by addition of water during placement; density increases with age of deposit. Drilling: usually moderately sasy; locally difficult because of logs and concrete.	Infiltration: medium to rapid. Runoff: slow. Susceptibility to erosion: slight in rubbish; very high in earthfill cover.	Permeability: high in rubbish; low in earthfill layers. Water table: depth varies; water may puddle in depressions on underlying surface. Yield to wells: negligible. Quality: probably polluted. Use: none practical.	unsuitable. Dump sites: should be evaluated relative to character of underlying unit.	settlement excessive; improves with age of deposit but probably poor at best.	ery poor.	Extremely poor. Maximum damage to structures en similar material reported elsewhere in seismically active areas. Mostly poor,	Bonconstruction purposes only. Reclaimed land desirable for parks, playgrounds, golf courses, trailer courts, ote. General construction
Barthwerk Po	het applicable.	Chiefly earth and some rock mostly obtained locally and built into earthwork including landfills and highway and dan embankments. Older dem embankments may have variable deneity, and may overlie "Organic silty sand and gravel (Smo)." Neet is compacted during placement. Thickness of deposits mapped ranges from 5 to 30 ft.	Ridgelike or terracelike. As much as 30 ft of surface relief locally.		Excavation; generally easy with power equipment. Compaction: generally easy with power equipment. Drilling: generally very	Infiltration: varies. Runoff: varies, depending chiefly ea soil texture, slope, vegetal cover, and compaction. Susceptibility to erosion: very high by sheet and gully vash where unprotected by vegetation or surfacing, and by stream scour where not protected from stream by riprap.	most dams. Yield to wells: varies. Quality: varies. Use: none practical.	varies; percolation too slow to marginal. Dump sites: poor to fair in abandoned ponds and reservoirs because risk moderate of local ground- water pellution.	for roads and light structures; locally poor for heavy structures.	Generally good, if compacted; locally poor; in a few places potentially hazardous Side slopes 1 1/2 horizontal to 1 vertical generally safe where well compacted and fill and subsoil well drained. Stability investigations recommended for existing fills—and prior to building on or near new fills—on hillsides having slopes greater than 11 1/2° (20 percent) and on ether fills more than 30 ft high. State regulations require support or \$5° repose in excavations.	particularly where thick, or where fill over- lies alluvium er landslide deposits.	purposes.
Robble fill	Not applicable.	Blocks, slabs, and angular fragments of rock mostly obtained locally from railread cuts and tunnels and built into rockfill embankments. Interlected and stabilized during placement; very persons. Thickness of deposit 5-80 ft.	Ridgelike. As much as 80 ft of surface relief.	None.	Excavation: moderately easy with large bulldozers and power shovels. Compaction: moderately easy with tracked power equipment. Drilling: difficult.	Infiltration: rapid. Runoff: negligible. Susceptibility te erosion: very slight.	Permeability: extremely high. Water table: generally none; water moves in thin sees along base of fill. Yield to wells: negligible. Quality: not applicable. Use: none practical.	Uncuitable.	Good.	Generally good.	Fair where fill over- lies hard bedrock.	
Sandstone rubble Res	Talus (in part)	Blocks, slabs, and angular fragments chiefly of hard sandstone and conglowerate; average size about 6-12 in.; common size 4-5 ft; maximum size about 30 ft. Loosely interlecked; very porous. Masses commonly 10-20 ft thick.	Steeply sloping surfaces at foot of cliffs. Maximum slope angle about 35°.	net observed.	Excavation: moderately easy to difficult with large bulldozers and power shovels but hazardous because of slope instability. Compaction: moderately difficult with power equipment because of numerous large blocks. Drilling: very difficult.	-	Same as for above.	Univitable.	Bazardous because of slope instability.	Heardous. Areas subject to frequent rockfalls. Large stenes or entire masses prene to slide where downhill support removed by sresion or excavation; entire mass commonly at angle of repose.	Extremely poor. Hazard of rock- falls and slides.	Source for riprap, rockfill, and landscape rock.
Quartsite rebble Rq	Collevian (in part) Talms (in part)	Gravel and sand, very bouldery: (GP, some GWA/); poorly graded (well sorted); dense to very dense; stratification absent to very crude; crude beds of sandy gravel (65 percent gravel, 30 percent sand, and 5 percent silt and clay) interlanse with beds of angular quartsite boulders as large as 8 ft maximum dimension; light yellowish gray. Derived chiefly from thoroughly fractured and mended quartsite; stooes equidimensional and angular. As such as 25 ft thick.		Not observed.	Excavation: moderately easy to difficult on moderate slopes because of vide range in size of rubble; hazardous on steeper slopes because of slope instability. Compaction: moderately easy where larger blocks are absent or removed; vibratory compactors should be used. Drilling: generally moderately difficult because of large blocks.	Infiltration: very rapid. Runoff: medium te slow. Susceptibility to erceion: moderate by stream scour and sheet wash.	Permeability: very high. Other specific properties unknown; ground water probably moves in thin seed along bedreck surface.	Septic systems: probably varies; percolation locall; satisfactory but mostly too fast. Dump sites: poor because risk moderate of ground-water pollution.	Good to excellent.	Generally good; gravel tends to ravel and accumulate at angle of repose. Rockfalls from "Quartsite (q)" hazardous along base of steep slopes. State regulations require support or \$5° repose in excava- tions.	Pair vhere rockfall hasard absent.	Pessible local source of course aggregate for comercie.
Cobbly gravel and sand OS	Valley alluvium (in part)	Oravel and sand, coobly to bealdery: (OM, CRC); well graded (peerly serted); desse to very dense; cross stratification crude in 2- to 5-ft-thick lenses; lateral extent of lenses as much as 80 ft; light-yellowish-brown to pale-reddish-brown color from iron oxide. Free of silt- and clay-site fraction in comparison with "Silty bouldery sand and gravel (Smb)." Grades into "Silty bouldery sand and gravel (Smb)." near margins of deposit. May contain sparse lenses of compressible sandy clay about 1-2 ft thick and covering as much as several hundred square feet, commonly organic where at surface of gravel. Derived mostly from igneous rocks; stones commonly equidimensional and rounded. As much as 27 ft thick.	terrace along South Boulder- Creek.	Well-developed ancient soil profile commonly present mear surface along outer margins of South Boulder Creek valley: clayenriched zone (hardpan) about 12 in. thick is underlain by carbonate-enriched zone, a faint pala-brown to white layer in subsoil; commonly absent.	Excavation: moderately easy with power squipment; slowed by numerous boulders; boulders decrease in frequency from mountain front eastward. Compaction: mederately difficult; vibratery compactors commonly used; removal of large boulders makes easier. Drilling: generally moderately difficult because of boulders.	Infiltration: mostly medium to rapid; very rapid where clay- enriched zone absent. Runoff: slow; water may accumulate in shallow depressions for as long as a day; susceptible to flooding near stream. Susceptibility to erosion: moderate by stream scear; slight by sheet and gully wash.	Permeability: high. Water table: generally 5-15 ft below terrace surface along South Boulder Creek. Yield to wells: commonl 10 gpm or less; locall as much as 30 gpm. Quality: very hard; easily polluted locally. Use: estimated good source for certain industrial uses, cooling, irrigation and stock water; may require treatment for domestic and public supply locally.		Generally good below depth of about 2 ft. Heavy structures founded over sparse small lenses of compressible organic elay may settle unevenly.	Good; newly cut vertical slopes as much as 15 ft high commonly stand for months in gravel pits, but ravel or slump to angle of repose on wetting and drying over period of several seasons, or if below water table. State regulations require support or 15° repose in excavations.	Pair.	Lecal source of good-quality aggregate; pervious shells of dams and dikes; crushed rend metal.
Silty bouldery sand and gravel Sub and Gmb	Valley alluvium (in part) Colluvium (in part) Verdos Alluvium Rocky Flats Alluvium Pre-Rocky Flats alluvium	Band and gravel, silty to very clayer, pebbly to bouldery: (SC, GC; some SM, GC='); well graded (poorly sorted); stratification poor, beds 2-5 ft thick, discontinuous laterally; reddish-brown color from iron smide. Subderived from shiefly sendstone and red siltstone and Gmb from chiefly quarteits; stones commonly irregular in shape and subangular. Lower 3-15 ft of unit commonly grades into "Pubbly bouldery clay (Gpb)." As much as 35 ft thick.	stream-dissected	Well-developed ancient soil profile generally present: clay-snriched zone (hardpan) near surface as such as 18 in. thick is underlain by carbonate-enriched zone (caliche). Granite boulders within ancient soil zone weathered, some decomposed; slightly weathered in lever part of unit.	Excavation: generally easy with power equipment; generally difficult for light backhoes and trenchers within 1 mile of mountain front because of numerous large boulders; boulders decrease in frequency eastward. Compaction: moderately easy; vibratory compactors and smooth- tired rollers commonly used; easy where large boulders are absent of rem@wed. Drilling: generally moderately easy; moderately difficult where large boulders numerous.	medium; rapid where clay-enriched some absent. Runoff: slow where surface flat; medium on slopes. Susceptibility to erosion: generally moderate by sheet and gully wash; high along banks of stream and where unprotected in senstruction areas	dissolved solids and	soil. Effluent t of many systems would contaminate ground water and may contribute to instability of slopes along	Generally good below some of clay enrichment and frost heave about 2 ft. Heavy structures founded within a few feet of "Pebbly bouldery clay (Cpb)" may settle unevenly; slabs may be heaved by swelling in elayenriched some.	Pair; newly cut nearly vertical slopes as much as 10 ft high commonly stand several months in borrow pits, but ravel or slump on wetting and drying over period of several seasons, or if below water table. Slopes higher than 10 ft probably safe at 1 1/2 horizontal te 1 vertical where subseil well drained. State regulations require support or 45° repose in excavations.	Pair.	Source locally for fair- to good- quality road metal and embankment fill.
Organic silty cond and gravel See	Valley alluvium (in part: Piney Creek Alluvium)	Sand and gravel similar to "Silty bouldery sand and gravel (Smb)" but with upper 1-5 ft commonly pebbly organic ellt: (SM, OL-). Upper part very well graded (poorly sorted); stiff, brittle when dry; soft sticky when wet; stratification moderately good, beds several inches to as much as 2 ft thick, fairly continuous laterally. Total thickness as much as 15 ft.	Long narrow low terraces along some streams east of mountains. Gentle slopes adjoining guilies locally within the mountains.	soil profile generall present at surface; clay-exriched some characteristically about 8 in. thick.	Excavation: generally easy with power equipment. Compaction: moderately easy; vibratory compactors, rollers commonly used. Organic layer should be removed where human is more than 10 percei by volume. Drilling: generally easy.	medium. Runoff: slow to medium; susceptible to flooding near streams. Susceptibility to erosi-n: moderate by stream scour on	y Permeability: low to high. Water table: generally 5-15 ft below surface. Other specific properties same as for "Bilty bouldery sand and gravel (Smb, Cmb).	(Smb, Gmb)." Dump sites: Bame.	Poor in organic layer, which may heave slabs or compress under structures when water added. Same as for "Silty bouldery sand and gravel (Sab, Omb)" below organic layer.	Same as for "Silty bouldery sand and gravel (Smb; Omb)."	Poor te fair.	Organic layer possible source of topacil for landscaping if pebbles removed; generally unsuitable for construction purposes.
Bouldary gravel and clay GCb	Terrace allevius	Gravel and clay interbedded, bouldary. Beds range in composition from very clayey silty bouldary gravel to very pebbly silty bouldary clay. Gravel (OC ¹ /) is medium dense to dense, reddian-brown color from iron oxide; clay (CL ¹ /) is stiff, plasticity law to medium, yellowish-brown color from limonite. Includes 5-ft-thick zone of caliche which generally lies about 2 ft below surface; dense, upper part loosely cemented, pale-brown color from calcium carbonate and some iron oxide. Generally very well graded (poorly sorted); stratification crude, lenticular, lenses mostly 2-5 ft thick. Derived mostly from sedimentary rocks. Stones commonly sand-stone, subangular, some granits; 18-in. blocky bouldars common. As much as 35 ft thick.	stream-dissected terrace.	Same as for "Cobbly gravel and sand (GS)."	Excavation: generally easy with heavy power equipment. Compaction: moderately easy, saroth-tired rollers commonly used where boulders absent or removed, sheepsfoot reliers most commonly used. Drilling: generally moderately easy; moderately difficult where large boulders mumerous.	erosion: moderate by		Beptic systems: generally satisfactory; percolation marginal to too slow locally. Dump sites: peer because risk generally moderate of ground-water pollution.	Generally fair to good below zone of clay enrichment and freet heavs (about 2 ft). Heavy structures founded over numerous lanses of compressible silty clay may settle excessively or unevenly Slabs may be heaved by swelling in clayenriched zene.	Same as for "Bilty bouldery sand and gravel (Sub, Qmb)."	Pair.	Source locally for fair-quality read metal and cubankment fill.
Bouldery sand, silt, and clay acb	Colluvium (in part) Slocum Alluvium	Sand, gravel, silt, and clay, bouldery, micaceous: (SC, GC; some CL, SW, GW±/); very well graded (very poorly sorted); stratification crade to absent, discontinuous; generally dense to very dense. Where unit overlies "Red silt-stone (ms)," plasticity slight, reddsh-brown color from iron exide. Where unit overlies claystone east of mountain front, generally similar to "Silty bouldery sand and gravel (Smb, Gmb)" except contains sparse lenses of porous compressible sandy clay commonly a few feet thick and covering as much as a few acres, plasticity medium to high; medium stiff; olive-gray color from clay matrix. Stones mostly siltstone and sandstone, subangular; blocky and flaggy boulders common. Thickness differe from place to place; generally less than 25 ft thick but locally as much as 60 ft.	Pans and aprons with gently to moderately rolling surfaces near mouths of streams draining hogbacks and gently undulating surfaces sloping 10°.35° into valleys adjacent to hogbacks.	May locally contain carbonate-enriched some as in "Cobbly gravel and sand (GS)." Pebbles and cobbles of granite and reddish-brows conglomerate slightly decomposed.	Excavation: generally easy with heavy power equipment; moderately difficult with light backhees and trencher within 1 mile of mountain front became of numerous large boulders; boulders decrease in frequency eastward. Compaction: moderately easy, smooth-tired rollers commonly used where boulders absent or removed, sheepsfoot rollers most commonly used. Brilling: generally moderately easy; moderately difficult where large boulders numerous.	surface flat; rapid on slopes. Susceptibility to erosion: moderate; high where unpretent by vegetation. Susceptible to mid flowage where loosened by excavation and saturated.	Permeability: varies locally from low to high. Water table: ranges widely: east of mountain front from 5 to 30 ft below surface, depending chiefly on bedrack topography and permeability; usually absent in valleys adjacent to hogbacks. Yield to wells: common 15 gpm or less east o mountain front; negligible elsewhere. Quality: very hard; dissolved solids and sulfate content high; easily polluted. Use: estimated good mountain front for lawn irrigation, cooling and stock water; requires treatment for domestic use.	unsatisfactory where thin, but depends chiefly on nature of underlying bedrock. Dump sites: fair i valleys adjacent	Varies; very poor to fair depending chiefly on thickness and texture of material, slope of bedrock surface, ground-water conditions, and loading. Leads greater than 3,000 psf bearing within a few feet vertically of sandy clay lenses may cause uneven settlement of building.	East of hegbacks same as for "Silty bouldery sand and gravel (Smb, Cmb)." Within valley adjacent to hogbacks, generally poor because of steep terrain; nearly vartical cuts as much as 10 ft high commonly stable where crown of backslope and subsoil well drained; slope failures observed in highe poorly drained cuts. Failures in natural and cut slopes most commonly occur where ground water is excessive as indicated by springs, seeps, or vater-loving plants, where slopi bedrock surface undercut, or where crown of slope leaded excessively; stability investigations recommended before grading on slopes. State regulations require support or h5° repose in excavations.	ng .	Source locally for fair-quality road metal and embankment fill.
Pebbly bouldary clay Cpb	Collevium (in part)	Clay, mostly pebbly to bouldery, clayey sand locally: (CL, CH, some SCL'); dark olive brown and yellowish to reddish brown; stiff to vary stiff; plasticity low to medium where unit overlies nonswelling to slightly swelling bedrock (cs-ma, sh-ma), medium to highly swelling bedrock (cs-mh, cs-mm); generally desiccated, relative swelling potential essentially same as underlying bedrock. Upper 1-2 ft may include organic clay near base of slopes. Stratification generally absent. Derived chiefly from claystome bedrock. Thickness differs from place to place; as much ma 30 ft thick; deposits less than 3 ft thick not mayped.	steep slopes flanking mesas and ridges east o mountain front. Haximum slope	Profiles of ancient soils including 6-to 12-inthick hardpan may locally be present at surface or buried in unit.	Excavation: easy with met power squipment. Compaction: generally easy; sheepsfoot and lightweight rollers commenty used. Trafficability very poor when wet. Drilling: very easy.		Permeability: negligib to low. Water table: generally absent; ground water may move in thin zone along bedrock surface Yield to wells: negligible. Quality: where present very hard; dissolved schids and sulfate content high; may locally corrode steel pipe and react with certain cement. Use: neme practical.	generally unsatisfactory; percolation too slow to marginal; effluent contributes to slope instability. Dump sites: good; risk slight of ground water	on slope, load, foundation design, and change in moisture	springs, seeps, or water- lowing plants, where slopi bedrock surface undercut of where crown of slope loads excessively by fill. Stability investigations	ng r	Source of poor quality land fill; possibly good for core material of earthfill dam.